

TRIAL LECTURES FOR ACCELERATOR OPERATORS IN SPRING-8

T. Ohshima[†], SPring-8, Hyogo, Japan

Abstract

In case of the SPring-8, accelerator operators are working in three shifts of eight hours. They are making the scheduled beam injection to the storage ring, routine measurements of beam parameters such as the COD, the betatron tunes, the bunch current of stored beam and so on. They are keeping watch on operational state every time. In case of something wrong, they will take measures to meet the situation. Newcomer of operator works with an experienced one to learn sequence of the beam injection, how to operate Graphical User Interface and (GUI) so on. In addition, we organise preliminary lectures on accelerator for operators. Topics done in the lectures are RF system, vacuum system, magnet system, monitors, beam diagnostics, accelerator and beamline control system etc. The contents of the lecture can be seen through web browser again and again. It is useful for operators to understand the SPring-8 facility and details of their work because some of them are not familiar with the accelerator field before being an operator of SPring-8.

1 INTRODUCTION

The SPring-8 is one of synchrotron radiation (SR) facilities of third generation [1,2]. The nominal beam energy is 8GeV, the maximum stored beam current of 100mA, the beam emittance of 3.6nmrad. 62 beamlines can be installed and now 44 beamlines are in operation. In these beam lines, photon energy range up to 300keV can be used. The injectors consist of a 1 GeV linac and an 8 GeV booster synchrotron. And also another storage ring named as New SUBARU, which is steered by the Himeji Institute of Technology, is located on same campus as one of the SPring-8 accelerator complex. It is 1 - 1.5 GeV SR source with the photon energy range from VUV to soft X-ray. The operators in SPring-8 are working on these four accelerators.

The total operation time of the accelerator complex was, for example, 5543 hours in 2002. The user time was 3896 hours (about 70.8% of the operation time). There are successive operation periods, which is called "cycle". In 2002, the operation had been done with 11 cycles. The one operation cycle lasts four or five weeks. The operation cycle starts on Wednesday. After 12 hours for machine tuning and 12 hours for beamline tuning, then user time starts. During user time, there are beamline studies for 24 hrs and machine studies for 48 hrs. Figure 1 shows the operational statistics.

The schedule is confirmed by the meeting before every

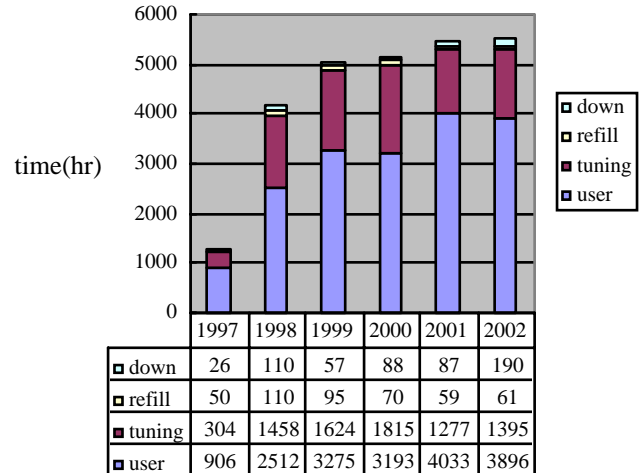


Figure 1. The operational statistics since 1997.

operation cycle. The brief meeting is also held at 9:15 to 9:30 on Monday, Friday and the day at starting the beam operation, beamline study and machine study. The members attending to the meeting are staffs of linac, booster synchrotron, storage ring, New SUBARU, beamline, safety, utilities and secretary.

In SPring-8, accelerator operators are working in three shifts of eight hours, "shift I" starts from 9:00 to 17:00, "shift II" from 17:00 to 25:00 and "shift III" from 1:00 to 9:00. Numbers of operators for each shift is four. Total number of operators is twenty. The eldest operator has been working seven years in SPring-8. About seven persons were exchanged from 1997 to now. In addition to operators, staff members of the accelerator division take turns working for shift leader. The shift leader is responsible for the matter related to the accelerator operation. Numbers of shift leader are one except for midnight shift of two.

2 DUTY OF OPERATORS

The important mission of the SPring-8 operation is to deliver stable SR to users with good quality. To accomplish it, we take care to make an operation on schedule and quick recovery in case of troubles such as beam abort.

As for regular beam injection to the storage ring, usual procedure is as follows. Before injection they will make announcement such as "Beam injection will start on 10:00." They will make adjustment of the beam current, fine-tuning of the beam energy of the injector. After injection, they

[†] ohshima@spring8.or.jp

measure beam parameters of the storage ring such as COD, betatron tunes. They will correct the COD if the distortion is larger than threshold level. And they will write down what they did in a logbook. Figure 2 shows one scene in beam injection procedure.



Figure 2. Picture taken when the beam-on switch is pushed.

Another duty of the operator is watching the machine status under instruction of the shift leader. If stored beam was lost, for example, the alert signal appears in the screen of the central control room with computer voice. The operator broadcast information on the trouble such as "The stored beam was aborted. The cause of the abort is under investigation". The candidate for cause of the abort is shown in GUI [3,4,5]. The operator checks the cause and cure it in case of easy trouble, such as large reflected power from RF cavity, arc in RF components, modulator down of linac due to over current, etc. If the trouble is serious one the shift leader calls the group leader who can cure the trouble. The group leader will nominate the staff to call. The specialist will cure the situation.

3 TRAINING

Since the carrier of each operator is different in various ways, we give a lecture for operator to help understanding of accelerator system. The lecture contains accelerator basics, frontier of what accelerator staffs are doing now and so on. The titles of lectures, which were done upto now, are listed below.

- RF system of the storage ring
- Ultra high vacuum
- Beam monitoring system
- Control system of accelerator
- Magnets and power supplies
- What is COD correction

- On insertion device ID23
- Design concept of booster synchrotron
- Control system of beamlines
- Beamline for beam diagnostics
- Radiation safety on operation of accelerator
- RF gun
- Super conducting wiggler

These lectures were held during machine maintenance period. The accelerator staff who knew the part very well made the lecture for about one hour. Operators could ask questions frankly to the staff during and after the lecture. The lecture notes are uploaded to a server PC and anyone in the SPring-8 site can browse them. It is important to give lectures repeatedly. So we will plan to organise lectures on same subject with different point of view, in addition to introduce most recent topics. Figure 3 shows one scene in typical lecture.



Figure 3. One scene of lecture on beam diagnostics beamline.

Another way to give operators information is done by preparation of some manuals. The operation manual is prepared for linac, booster synchrotron and storage ring. The details of sub-systems such as how to use GUI, the system composition, the typical operation parameters and so on are shown in the manuals. The manual is updated according to the improvement of the sub-system.

In case of trouble, the operators also refer to the failure report. This report contains information on the troubles occurred up to now, what was happened, what was the source of trouble and how to make recovery from the trouble. This report helps operators to identify what is the source of trouble and to find how to deal with it. However, some staffs are forgot to write documents, or they will think the trouble is not so serious one to write documents. We cannot prepare the perfect failure reports without omission,

because the criteria are not clear now. We will improve this situation in the near future.

The most practical training is experience of daily operation. The newcomer works with senior operators for a given period of time before attending to the nights' shift. The load of the newcomer is increased as his skill is making progress.

During the long shutdown period (two-months summer shutdown, one-month winter shutdown, and two-weeks shutdown in spring and autumn,) the operators are assigned to accelerator staffs and work on maintenance jobs such as alignment of magnets, exchange of vacuum chamber, maintenance of VME and so on. Through these work they bring about better understanding on accelerators.

Some of operators are working on making a GUI. The operator uses GUI daily. So it is nice to make GUIs by themselves because they can modify the GUI to user-friendly one. The online manuals of GUIs are prepared by operators. Figure 4 shows an example GUI. The online manual is updated when some GUI is modified.

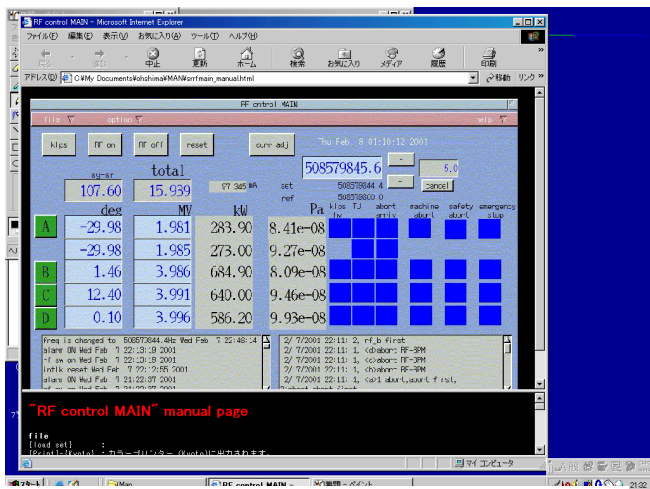


Figure 4. An example of online manual for a Graphical User Interface.

4 SUMMARY

The SPring-8 is successfully operated for these years. We make some lectures to operators and staffs to improve understanding of accelerator operation. We provide operation manuals to refer when something wrong has occurred. Further efforts will be made to promote the ability of operators.

5 ACKNOWLEDGEMENTS

The author would like to thank staffs and operators of accelerator division of SPring-8, Drs M. Takao and K. Soutome, especially to Mr K. Kobayashi and to Dr H. Ohkuma

6 REFERENCES

- [1] H. Ohkuma, et al, "OPERATIONAL PERFORMANCE OF THE SPRING-8 STORAGE RING" PAC'01, Chicago, June 2001
- [2] H. Tanaka, et al, "Recent progress of the SPring-8 facility" APAC'01, Beijing, Sept. 2001
- [3] M. Takao, "Software application for SPring-8 accelerator operations" WAO'03 Hayama, March 2003.
- [4] T. Ohshima, "Machine troubles during user time at the SPring-8", ARW'01 Grenoble, March 2001
- [5] M. Kodera et al, "A video monitoring system for SPring-8 accelerator tunnel" WAO'03 Hayama, March 2003.